The Current Account Balance: Part One

Barry W. Ickes

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1. Introduction

The current account balance is a measure of a country's transactions with the rest of the world. It includes all *current* transactions, hence the name. Its counterpoint is the capital account, which measures transactions involving IOU's. We will look at the capital account when we turn to the balance of payments, which includes both the current and capital accounts. Now our attention is on the determinants of the current account.

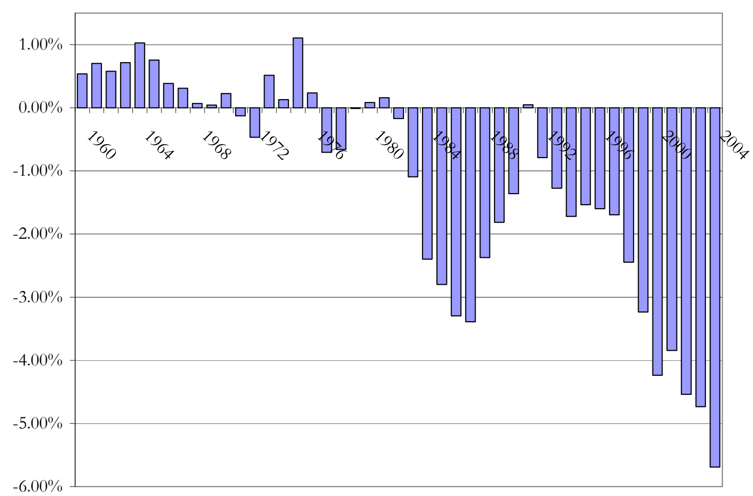

Figure 1: Current Account Balance of the US as a Share of GDP

One thing we know is that the current account balance of the US is negative, and that this deficit keeps growing (see figure 1). We want to understand why a country would run a current account deficit and what are the implications. This will enable us to later study how a country can adjust to restore balance to the current account.

If a country runs a current account deficit it must be borrowing from the rest of the world. Hence, if the US has been running current account deficits for some time, it must mean that

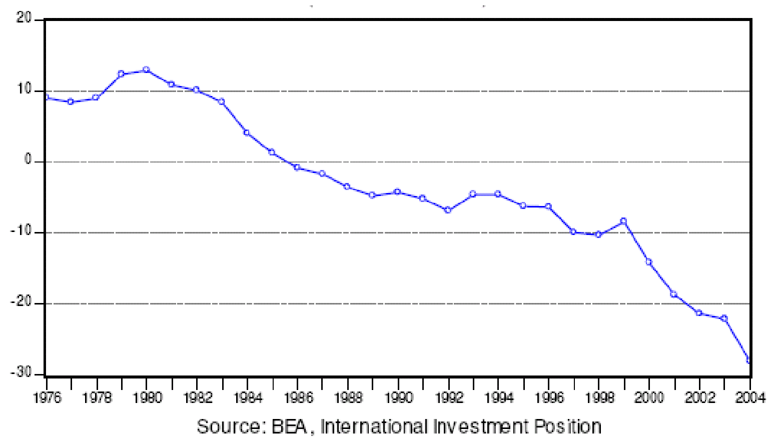

Figure 2: US Net International Investment Position (share of GDP)

our debt has increased, or our net international investment position has decreased.[1] This is evident in figure 2. One can see that until the mid-1980's the US net position was positive – the US was a net international creditor. Since then, however, the US has become the world's largest debtor. So the question about sustainability of the current account deficit can be framed another way: for how long will the rest of the world allow the US to keep going further into debt? There is a limit to how long a private agent can do this. What about a country? What about a reserve-currency country?

One way to think about the net international investment position (or net foreign assets) of a country is just the cumulative sum of the current account, i.e., $NFA_t = \sum_{i=1}^{\infty} CA_{t-i}$, where NFA are net foreign assets at time t, and CA_t is the current account balance of the country at time t. This would be good intuition: a person's debt is the cumulative total of past borrowing and lending. But there is an additional consideration: changes in the value of assets. Valuation effects can occur because the returns on assets we own abroad may differ from those foreigners own here, and also from capital gains and losses due to movements in the dollar. Normally one would think that these factors would balance out – why should a

[1] You might be tempted to think that the net international investment position is just the cumulative sum of the current account. This would be good intuition. A person's debt is the cumulative total of past borrowing and lending. But there is an additional consideration: changes in the value of assets. Valuation effects can occur because the returns on assets we own abroad may differ from those foreigners own here, and also from capital gains and losses due to movements in the dollar. It turns out that these valuation effects are quite important, so we shall discuss them in more detail later.

country enjoy such an advantage. But the US is a bit different, after all the dollar is the world's reserve currency. The US borrows in its own currency, something other countries cannot do.[2] And other countries may forsake returns to invest in a safe haven like the US. It turns out that these valuation effects are quite large, so it is worth some mention.

It is interesting to compare the naive measure with one that corrects for differences in returns and capital gains and losses. In figure 3 we have the naive and two estimates that include these valuation adjustments. Several things are apparent from the figure. First, the US in the mid-50's was a huge net creditor, with a stock of NFA equal to almost 15% of GDP, while now the US is a big debtor, the stock of NFA almost -26% of GDP. Second, notice that on the naive measure the US becomes a net debtor sooner than actual – in other words, the exorbitant privilege has helped our true status. Third, when the US was a creditor the naive measure overstated the true position – it made the US net foreign position seem more positive, and now the opposite. This last point means that the valuation effects have been stabilizing.

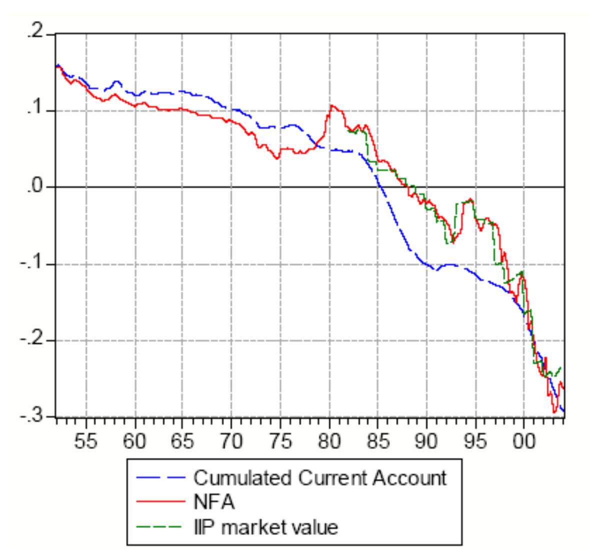

Figure 3: US NFA Relative to GDP

To see this, define the valuation effect as simply the difference between our "true" net foreign assets (NFA^*) and the naive measure: $VE = NFA^* - \sum_{i=1}^{\infty} CA_{t-i}$. The valuation effects

[2] De Gaulle was reputed to have called this an "exhorbitant privelege," but apparently it was his finance minister, Giscard d'Estaing who really said it.

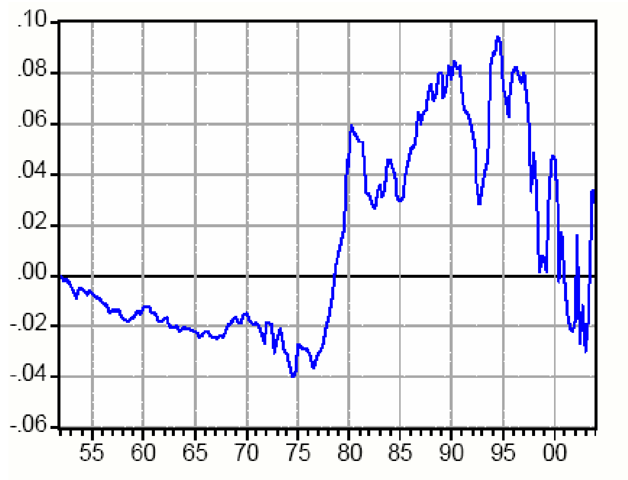

Figure 4: Valuation effects

are displayed in figure 4, and we can see that during the Bretton Woods period they were in fact negative, while since the breakdown of Bretton Woods they are positive. Essentially, valuation effects were negative when the US was a net creditor and are positive now that the US is a net debtor. The interesting question is to explain the source of the privilege, but we leave that for a bit later. Now we turn to the determination of the current account balance.

The current account balance is comprised of the trade balance and other current types of transactions, such a flows of investment income, tourism, and foreign aid. One important determinant therefore is the real exchange rate which is the relative price of foreign goods relative to domestic goods. But that puts the cart before the horse. It is most useful to start by considering an intertemporal framework, that is, by thinking about choices over time. We can ignore for the moment the relative price of goods produced in different countries and focus on goods produced at different points of time. We can learn a surprising amount with such a simple approach.

1.1. The Current Account in an Intertemporal Framework

Typically we think about trade in goods and services when we speak about the current account, but this is not the simplest way to begin. More basic, in fact, is trade across periods: intertemporal trade. This gives us an alternative way to think about the current account from the conventional focus on imports and exports. It shows us a different causal factor with regard to the current account. And it is very useful for thinking about capital flows.

Consider a small economy with identical consumers. They choose consumption to maximize utility:

$$U = u(C_1) + \beta u(C_2) \tag{1}$$

where β is the discount factor. Agents desire to smooth consumption, and this behavior extends to the economy as a whole.[3]

Income in each of the two periods is given by Y_1 and Y_2. We can think of these at first as endowments – manna from heaven. If the economy were closed then the problem would be trivial: $C_1 = Y_1$, etc. But if borrowing and lending are allowed, then consumption possibilities are subject to the intertemporal budget constraint:

$$C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r}. \tag{2}$$

Consumption does not have to be at the endowment point, but can be at a preferred point, as in figure 5. Welfare is clearly higher due to access to world capital markets.

We maximize equation (1) subject to the constraint (2). The first-order conditions imply:

$$u_{c_1} = (1+r)\beta u_{c_2} \tag{3}$$

or

$$\frac{\beta u_{c_2}}{u_{c_1}} = \frac{1}{1+r} \tag{4}$$

where u_{c_1} is the marginal utility of consumption in period one. Expression (4) is just the familiar condition that the marginal rate of substitution between the present and future consumption and the right-hand side is the price of future consumption in terms of present consumption.

Expression (3) is called an Euler equation. Notice what it implies. At an optimum the agent must be indifferent between consuming today or tomorrow. Otherwise it could not be

[3] We abstract from differences among households in the economy to focus on differences across economies.

an optimum. Now suppose an agent reduce consumption by one unit this period. Utility would fall this period by the marginal utility of consumption, u_{c_1}, the left-hand side of (3). But consumption would be higher next period. By how much? A unit saved today raises consumption by $1+r$ next period. And so utility rises by $(1+r)u_{c_2}$. But we have to discount this back to the current period, so we multiply by β, and this gives the right-hand side of (3).

Now suppose that $\beta = \frac{1}{1+r}$, then it follows that consumption would still equal income in each period. We can call this interest rate the *autarchy* rate of interest, r^a.[4] Notice that $\frac{1}{1+r}$ is the rate at which future consumption can be transformed into present consumption, and β is the rate at which we discount future over present consumption. When these two are equal we do not want to alter our consumption profile. Everybody has an autarky rate of interest, though it will be different for different individuals or economies. It is a benchmark interest rate that we can use to assess whether the economy will borrow or lend in the current period.

Whether this economy will engage in international borrowing or lending depends on the actual terms of trade: in our case the world interest rate. Suppose that the world interest rate is less than the autarchy interest rate, $r < r^a$. This means that the premium required to induce people to smooth consumption is greater than what can be had with international lending. Hence, current consumption will rise relative to autarchy, while second-period consumption will decrease. Thus we will have borrowing in period one equal to $B_1 = C_1 - Y_1$. In the next period the borrowing must be repaid. Hence, $C_2 = Y_2 - (1+r)B_1$.

Now the current account balance in an economy is the change in the value of its net claims on the rest of the world. In our simple model, with only consumption, the current account balance is equal to national savings, which is negative in our example. In a model with investment, the current account would equal the difference between savings and investment. In general, if A_t is the economy's net foreign assets at the end of period t, then the current

[4] Note that if $\beta = \frac{1}{1+r^a}$ then $1 + r^a = \frac{1}{\beta}$ and thus $r^a = \frac{1}{\beta} - 1 = \frac{1}{\frac{1}{1+\delta}} - 1 = 1 + \delta - 1 = \delta$.

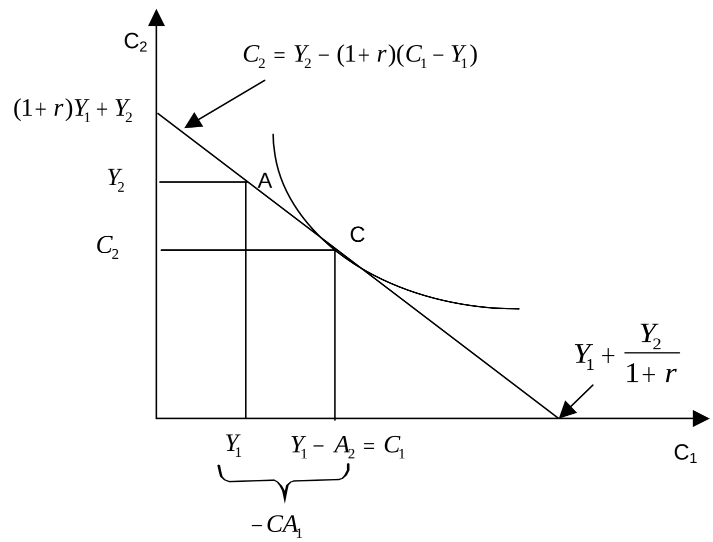

Figure 5: Consumption over Time and the Current Account

account can be defined as:

$$
\begin{aligned}
CA_t &= A_{t+1} - A_t && (5) \\
&= Y_t + rA_t - C_t && (6) \\
&= NX + rA_t && (7)
\end{aligned}
$$

where NX is the net exports (exports less imports, also called the trade balance).

Remark 1 *It is useful to recall national income accounting. In this model without investment or government, we have only two uses for output: consumption and net exports. Hence,* $Y \equiv C + NX$.

The economy will run a current account deficit today: the rest of the world acquires claims on the economy's future income. Next period, the economy's current account will be in surplus; this must occur in a two-period model. That is, the current account in period two will be equal to the negative of the current account in period one, plus interest:

$$CA_2 = Y_2 + rA_2 - C_2 = Y_2 + r(Y_2 - C_2) - C_2 \tag{8}$$

But in a two-period model A_2 must be zero, so:

$$CA_2 = NX_2 = Y_2 - C_2$$

in period two the current account is equal to net exports as there is no further lending.

But we know from (2) that $C_2 = Y_2 - (1+r)(C_1 - Y_1)$. Hence,

$$\begin{aligned} NX_2 &= Y_2 - C_2 \\ &= Y_2 - \{Y_2 - (1+r)(C_1 - Y_1)\} \\ &= -(1+r)(Y_1 - C_1) = -(1+r)NX_1. \end{aligned} \tag{9}$$

or

$$NX_1 + \frac{NX_2}{1+r} = 0 \tag{10}$$

the present value of the country's borrowing must be zero. This is just an intertemporal budget constraint.[5]

Remark 2 *Strictly (10) is true because we started the first period with zero assets. More generally, we should assume that we enter the initial period with some level of assets that could be positive or negative. Suppose we entered period one with net foreign assets equal to* A_0. *Our intertemporal budget constraint would thus be*

$$C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r} + A_0$$

Thus, our lifetime resources are augmented by whatever assets we are born with (or debt burdened with if $A_0 < 0$). *Second-period consumption is now,* $C_2 = Y_2 - (1+r)(C_1 - Y_1 - A_0)$. *Then the last line in expression (9) above is now*

$$NX_2 = -(1+r)(Y_1 - C_1) - (1+r)A_0 = -(1+r)NX_1 - (1+r)A_0$$

[5] It may be easier to see this by noticing that if a country runs a current account deficit today it will have to repay the debt next period, plus interest. There will be a debt equal to CA_1 and in period two the debt will equal $CA_1(1+r)$. So $CA_2 = -(1+r)CA_1$, or $CA_1 + \frac{CA_2}{1+r} = 0$, which is just expression (10).

and thus equation (10) is now

$$NX_1 + \frac{NX_2}{1+r} = -(1+r)A_0 \tag{11}$$

which says that the present value of future net exports (the left hand side) is equal to principal and interest payments on initial net foreign assets. Thus, if we start initially with a debt (born with debt), $A_0 < 0$, the present value of future net exportss must be positive. If we are born with positive net foreign assets, $A_0 > 0$, then the present value of future net exports can be negative. Expression (11) will be useful for thinking about the US. Currently we have an initial level of debt. Hence, the present value of future net exports must be positive. So even if currently we have a negative net exports, solvency implies that somewhere in the future it will turn positive. We will return to this later.

1.2. Longer-Time Horizon

In a model with a longer time horizon we would modify the constraints which would allow periods of surplus and deficit to persist for several periods. This is straightforward. It is useful to begin with the definition of the current account balance:

$$CA_t = A_{t+1} - A_t = Y_t + rA_t - C_t. \tag{12}$$

This can be re-written as

$$-(1+r)A_t = Y_t - C_t - A_{t+1} \tag{13}$$

$$= NX_t - A_{t+1} \tag{14}$$

This is true for any period, so we can now move this forward one period:

$$-(1+r)A_{t+1} = NX_{t+1} - A_{t+2}$$

or

$$A_{t+1} = -\frac{NX_{t+1} - A_{t+2}}{1+r} \tag{15}$$
$$= -\frac{NX_{t+1}}{1+r} + \frac{A_{t+2}}{1+r} \tag{16}$$

Now use expression (16) in (13) to eliminate A_{t+1} :

$$-(1+r)A_t = NX_t - A_{t+1} \tag{17}$$
$$= NX_t - \left[-\frac{NX_{t+1}}{1+r} + \frac{A_{t+2}}{1+r}\right] \tag{18}$$
$$= NX_t + \frac{NX_{t+1}}{1+r} - \frac{A_{t+2}}{1+r} \tag{19}$$

and if you do this again you will get

$$-(1+r)A_t = NX_t + \frac{NX_{t+1}}{1+r} + \frac{NX_{t+2}}{(1+r)^2} - \frac{A_{t+3}}{(1+r)^2},$$

keep doing this and we have:

$$-(1+r)A_t = NX_t + \frac{NX_{t+1}}{1+r} + \frac{NX_{t+2}}{(1+r)^2} + \frac{NX_{t+3}}{(1+r)^3} + ... - \frac{A_{t+n}}{(1+r)^n}$$

Notice that each time we keep moving the net foreign debt term farther to the future. Suppose we kept doing this all the way to some T far in the future. We would have:

$$-(1+r)A_t = \sum_{s=t}^{t+T} \left(\frac{1}{1+r}\right)^{s-t} NX_s - \left(\frac{1}{1+r}\right)^{T} A_{t+T+1}. \tag{20}$$

Expression (20) is interesting. The first term is just the present value of *net imports*.[6] The second term is the present value of net foreign debt sometime far in the future. Let's examine this term first.

How should we think about this "terminal" value of net foreign assets? In a finite horizon model we know this would have to be zero: we cannot have negative net assets in the last

[6] Or the present value of the negative of net exports. Or the present value of the negative of the trade balance.

period of life since there is no future in which to pay it back. But it could not be optimal to have positive net foreign assets in the last period because we would never get to consume. So in a finite horizon model we would have something like $(1+r)^{-T}A_{t+T+1} = 0$. Of course this can be true only if $A_{t+T+1} = 0$. Now in the infinite horizon we just let $T \to \infty$. As $T \to \infty$ we require the present value of future net foreign assets to go to zero: $\lim_{T\to\infty}\left(\frac{1}{1+r}\right)^T A_{t+T+1} = 0$ [7]Why?

These considerations imply that our intertemporal budget constraint can be simplified. It now can be written as

$$-(1+r)A_t = \sum_{s=t}^{t+T}\left(\frac{1}{1+r}\right)^{s-t} NX_s$$

so the present value of future trade surpluses is equal to the initial debt we start with.

The key principle is that periods of deficit can only be sustained if lenders expect offsetting future surpluses. We shall see, in fact, that for a country to be able to borrow lenders must believe that the intertemporal constraint (expression 10 or its equivalent) will be satisfied. It is when lenders no longer believe that it can be satisfied that they stop lending. If they stop lending current account deficits fall immediately, so the constraint is satisfied, but in a rather painful way.

[7]Why? There are two cases to consider.

- If $\lim_{T\to\infty}(1+r)^{-T}A_{t+T+1} < 0$ we would be running a Ponzi scheme.[8]038<p type="texpara" tag="Body Text" >Charles Ponzi duped investors by offerring incredible returns, which he at first paid from the deposits of new investors. He originally planned to use the resources to arbitrage international postage stamp prices. But he never did. Once the source of new deposits slowed, his scheme unravelled. But his name is now attached to the Ponzi game. If you examine (20) it is apparent that with $\lim_{T\to\infty}\left(\frac{1}{1+r}\right)^T A_{t+T+1} < 0$ that the present value of what we spend is forever greater than what we produce. Foreigners would be lending to us continuously without end. Obviously our debt would have to grow faster than the rate of interest for $\lim_{T\to\infty}\left(\frac{1}{1+r}\right)^T A_{t+T+1}$ to be strictly negative. But they would not do so, since they could consume resources themselves. No economy will provide resources to another for free forever. Hence, we cannot have $\lim_{T\to\infty}\left(\frac{1}{1+r}\right)^T A_{t+T+1} < 0$
- What about the opposite: what if $\lim_{T\to\infty}(1+r)^{-T}A_{t+T+1} > 0$? This would mean that the present value of all the resources the home country uses never converges up to the present value of output. We would be making an unrequited gift to foreigners. This cannot be optimal. We would never consume all we produce.

Since we have shown that the present value of net foreign assets cannot become strictly negative or strictly positive as T goes to infinity, it follows that we have to have the condition that $\lim_{T\to\infty}\left(\frac{1}{1+r}\right)^T A_{t+T+1} = 0$.

As we shall see, determination of exchange rates and interest rates in the global economy are determined by these key factors: the time pattern of income, the desire to smooth consumption, and expectations about future consumption and income possibilities.[9]

1.3. Investment

So far, the only way to provide for future consumption was to hoard, or to lend to another country at the world interest rate, r. Now suppose that economies can also invest – that is accumulate capital goods. Capital goods may be purchased because they yield a return – output is higher if more capital is used. Investment is the process of increasing the stock of capital. The decision to invest involves a comparison of the rate of return from investing with that of lending.

We have production function that relates output to capital, $F(K)$. We note that the marginal product of capital is positive (notationally, $F_K > 0$), but that there are diminishing marginal returns (that is F_K declines as K increases). How does a country raise K? By investing; in other words by using some of the endowment to raise tomorrow's capital stock. Consider figure 6, with initial endowment point A. By using some of Y_1 for investment we can achieve the production point P^*. The difference $Y_1 - Q_1$ is equal to first period investment. The point P^* is the profit maximizing production point given the interest rate. You can see that by noting that any other point on the curve AB with the same slope has an intercept that is to the left of point E. Point E is the present value of production at point P^*, and point D is the present value of the endowment point A. Hence, you can think of the difference $E - D$ as the present value of the profits from investing until point P^*.

[9] The first discussion of consumption-smoothing behavior is probably the biblical story of Joseph in Egypt. Recall his forecast (dream) about 7 good years followed by 7 bad years. He proposed storing a fifth of grain production each year of plenty, was appointed Prime Minister by Pharoh, and helped Egypt avoid famine. Notice that he engaged in domestic investment at a zero rate of return (prior to depreciation). Why not invest abroad? Interest rates in Babylonia at the time were 20-33%. At such rates consumption could have been higher in all periods. That is, why didn't Joseph advocate international consumption smoothing? Presumably, it is because of the insecurity of such contracts at the time. Similarly, in the fall of 2002 Brazil had trouble borrowing even though interest rates are very high compared with world rates. When the central bank of Brazil tried to roll over its debt the auction flopped after election-wary investors demanded interest rates as high as 50 percent for the paper maturing after the Oct. 6 vote.) It is not just the interest rate that counts, but that returns related to risk.

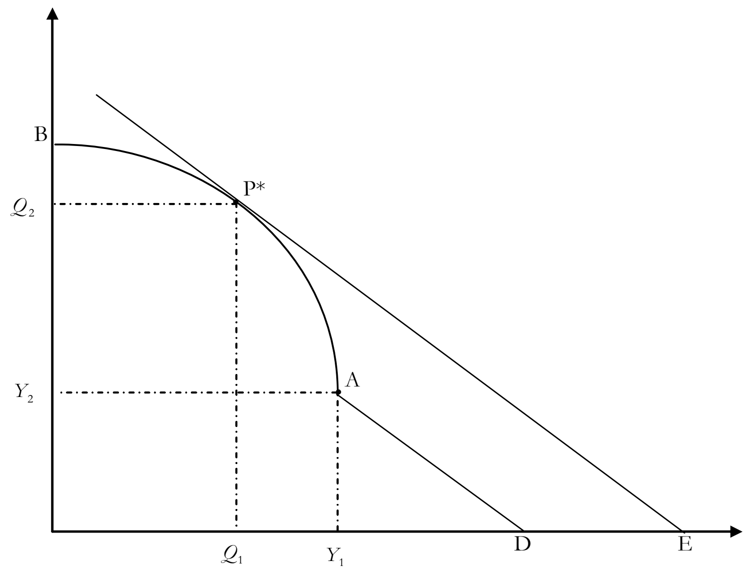

Figure 6: Production Possibilities

Notice that we have said nothing about consumption yet. The reason is that consumption choices depend on whether or not we can borrow or lend internationally. If the economy is closed then we are stuck to consume somewhere along AB. In figure 6 consumption in each period is also at P^*; there is noway to obtain more resources. Notice that consuming along the budget line between point P^* and E is impossible in a closed economy. So in the closed economy case you can see that $Y = C + I$, which follows since we already noted that $Y_1 - Q_1 = I$, and we noted that $Q_1 = C$.

Now suppose that we can borrow or lend at the rate of interest r, then our position is greatly augmented. Now investment and consumption decisions in a given period can be separated. We can invest more than the difference between current income and consumption. We can borrow from abroad. We now have figure 7, which has the same production possibilities as in figure 6, but we have added borrowing and lending. Given the interest rate and the preferences the consumption choice (C^*) is *separated* from the production choice. Notice that point C^* would not be feasible in a closed economy. I lays outside the production frontier. So international borrowing and lending (in this case borrowing in period one) improves welfare.

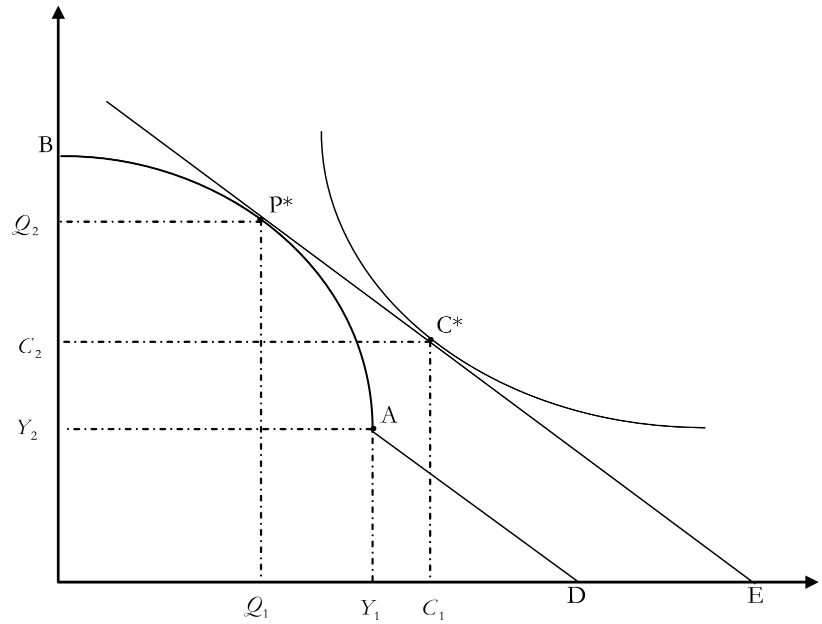

Figure 7: Production Possibilities in a Small Open Economy

We can see that in period one there is a current account deficit equal to $C_1 - Q_1$. In period two this is repaid as $C_2 < Q_2$.[10] In period two we are repaying principal plus interest but we are better off for it given the preferences as represented here.

What if there was initial debt? We would still separate decisions, but our consumption possibilities would be reduced by the level of initial debt. Suppose initial debt is A_0. We know that the present value of consumption is now reduced by $(1+r)A_0$. So given our endowment at point A, and the world interest rate, production is still maximized at point P^*. This leads to a present value of E. But we subtract from this the initial debt level and we have point W in figure 8. The optimal consumption C^*.

Allowing investment means that we now have two ways in which wealth can be held: foreign assets, A, and capital, K. Total domestic wealth at the end of period t is now $A_{t+1} + K_{t+1}$.

[10] Indeed, we can see more. Since the slope of a right triangle is the rise over the run, you can see that $\frac{Q_2 - C_2}{C_1 - Q_1} = 1 + r$. Now it is obvious that $\frac{Q_2 - C_2}{C_1 - Q_1} = \frac{CA_2}{-CA_1}$, so $\frac{CA_2}{CA_1} = -(1+r)$, which we can arrange as $CA_1 = -\frac{CA_2}{1+r}$, or $CA_1 + \frac{CA_2}{1+r} = 0$ as in expression (10) above.

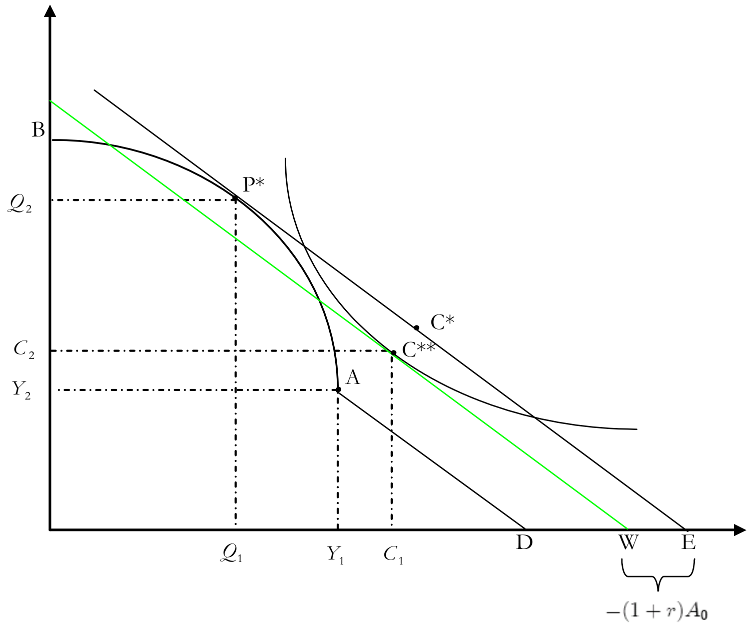

Figure 8: Production and consumption with initial debt

Ignoring depreciation,[11] the capital stock evolves according to

$$K_{t+1} = K_t + I_t. \tag{21}$$

We can write the change in domestic wealth, or national saving, as:

$$A_{t+1} + K_{t+1} - (A_t + K_t) = Y_t + rA_t - C_t - G_t \tag{22}$$

where I have added government spending, G, for completeness. The key point of (22) is that domestic wealth increases (sometimes called accumulation) only if earnings exceed spending on consumption (government included).

Now we can rearrange (22) using (21) to obtain the current account:

$$CA_t = A_{t+1} - A_t = Y_t + rA_t - C_t - G_t - I_t. \tag{23}$$

Notice that the first equality says that the current account surplus is equal to net accumulation of foreign assets.[12] And if we define savings, $S_t \equiv Y_t + rA_t - C_t - G_t$, then the current account

[11] Let δ be the rate of depreciation. Then expression (21) stands for the case of $\delta = 0$. If $0 < \delta < 1$, then we would re-write expression (21) as $K_{t+1} = (1-\delta)K_t + I_t$. If there is 100% depreciation ($\delta = 1$) then $K_{t+1} = I_t$.

[12] It is important to recognize that this is the negative of net capital inflow. Capital flows into a country as it accumulates liabilities. The lender acquires foreign assets.

can also be written as

$$CA_t = S_t - I_t. \tag{24}$$

In words, national saving in excess of domestic capital formation flows into net foreign asset accumulation. This points to the important point that the *current account is fundamentally an intertemporal phenomenon*.

How is investment related to the rate of interest? Notice that a higher interest rate means that the present value of future profits is lower. In the two-period model the net return to investment can be written as

$$\rho = -I_t + \frac{\pi^e_{t+1}}{1+r} \tag{25}$$

where π^e_{t+1} is expected future profits.[13] A higher interest rate means that ρ is lower, hence the demand for investment should decrease with the rate of interest (and rise with higher expected future profitability).[14] This gives us the negatively sloped investment function in figure 12.

It is interesting to look at the experience of Norway in this regard. In the mid-70's the Norwegian current account went into large deficit as investment increased to exploit energy resources. Savings also dropped, for permanent income reasons. The increased value of energy resources caused Norway to borrow against higher future income. This is evident in the time path of the current account as in figure 9.

Separation Theorem and the Small Economy In a small open economy the investment decision is separate from the consumption decision. Given the world interest rate, $\widehat{r}$, investment takes place where the marginal rate of transformation is equal to $1 + \widehat{r}$. Suppose that $\widehat{r} < r^A$. Then the country would invest to take advantage of productive opportunities.

[13] Notice that if there were more periods I could sell the capital good. But in the two-period case the world ends so the value of the capital good at the end of that period is zero, and profits are the only return.

[14] Actually, what we have actually shown is that the demand for capital goods depends negatively on the rate of interest. Investment is the change in the demand for capital goods. It is not immediately clear why this also depends on the rate of interest. Economists usually assume there are some adjustment costs that explain this. We will just assume it.

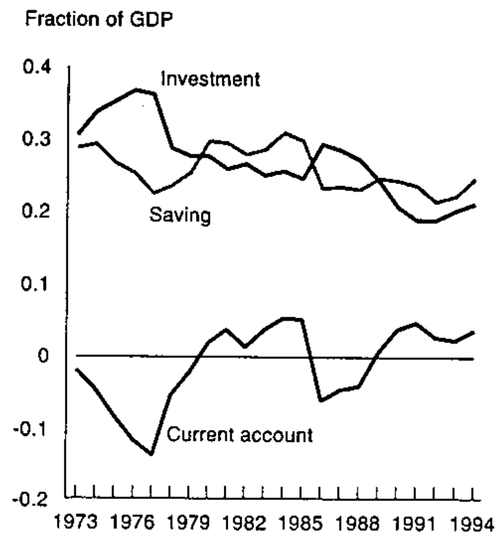

Figure 1.2
Norway's saving-investment balance, 1973–94. (*Source:* OECD)

Figure 9: Savings, Investment, and the Current Account in Norway

Consumption need not be reduced, however. Indeed a current account deficit can allow for greater consumption and investment than would be the case in autarchy.

In figure 10 the optimal production point is at $B*$, and the optimal consumption point is at $C*$. Notice that utility is higher at $C*$ than at the autarchy point. The economy runs a current account deficit in period 1 equal to $C_1 - Y_1$, while in period two there is a current account surplus. Two important implications follow from figure 10:

- production is more valuable at point B^* than at the original endowment point.
- welfare is higher at point C^*.

So access to the world capital market is beneficial for the small open economy – production and consumption opportunities are enhanced.

1.4. A Two-Country World Economy

Dealing with small open economies we could take the world interest rate as given. Let us briefly see how our analysis must change in a two-country model. Abstract from investment,

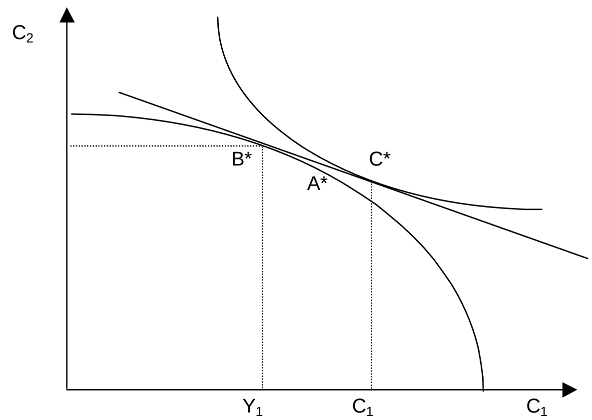

Figure 10: Investment and the Current Account

and let their be two economies, home and foreign (*), with exogenously given endowments. Notice that equilibrium in the global market requires

$$Y_t + Y_t^* = C_t + C_t^* \tag{26}$$

at each date t. This is equivalent to the statement that world savings must be zero,

$$S_t + S_t^* = 0. \tag{27}$$

Notice that this is also equivalent, because of the absence of investment, to the statement that the world current account must sum to zero, $CA_t + CA_t^* = 0$.

How is the world interest rate determined in this model? We make use of expression (27). Notice that savings in each country is an increasing function of r. Moreover, savings is negative when $r < r^A$ and savings is positive when $r > r^A$. Suppose that $r^{A*} > r^A$; the foreign country has a higher autarchy rate of interest than the home country. Equilibrium in the goods market thus requires that the world interest rate satisfy $r^A < r < r^{A*}$. This is evident in figure (11). Notice that at the equilibrium rate of interest, $S^H = -S^F$.

What happens if home output in period 2 increases exogenously? This raises the home country's borrowing at every interest rate. This amounts to a shift to the left of SS. The world interest rate must increase. Although the increase in Y_2 makes people better off due to increased total output, the home country must pay a higher rate of interest this period for its borrowing.

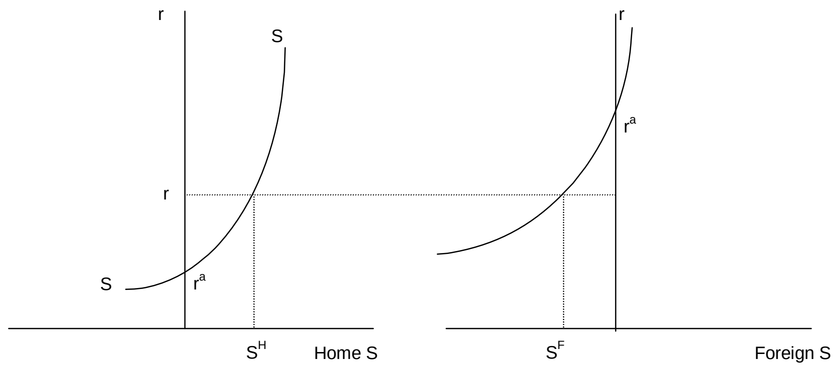

Figure 11: Interest Rate Determination in the Two-Country Model

One can interpret this as shift in the terms of trade. The home country imports current consumption from the foreign country. The increase in the world interest rate causes the terms of trade to move to the foreign country's advantage. The commodity that it exports is now more valuable than it used to be.

It should be clear that world welfare is enhanced when intertemporal trade is opened between these economies. You should be able to show that, starting at the autarky points in both countries intertemporal trade raises welfare in each.

Thinking about figure 11 one might characterize emerging economies as those where r^a is very high and the more mature economies as those where it is lower. This fits with the earning-consumption profiles of economies as well as individuals. The ability to transfer savings from the mature to the young enhances the opportunities of both.

1.4.1. Investment in the Two-Country Model

Now let us add investment, once again. Investment in each country is a negative function of the rate of interest. This follows from the principles of profit maximization (more below). We can plot savings and investment for each economy, but note that in an open economy savings and investment need not be equal in each country, only in sum. We have figure 12.

Notice that the excess of savings over investment in the home country is equal to the excess of investment over savings in the foreign country. This is what determines global equilibrium.

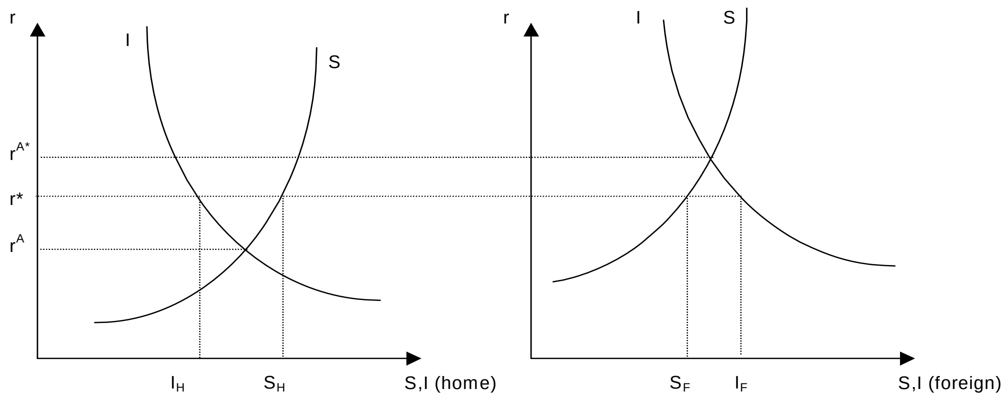

Figure 12: Global Equilibrium with Investment

Another way to express this is that world savings equals world investment:

$$S_t + S_t^* = I_t + I_t^* \tag{28}$$

which is equivalent to $CA_t + CA_t^* = 0$.

We can examine the impact of a change in foreign savings in the same way now. Consider figure 13. Initially, the world interest rate is equal to r_0^W. When foreign savings falls to S_1^* there is an excess demand for world savings at r_0^W. Hence, the world interest rate must rise to r_1^W, which causes both home savings to rise and reduces the demand from the foreign country.

Notice that we could equally well describe this in terms of current accounts. At r_0^W the home country has a current account surplus and the foreign country a current account deficit. When foreign savings falls, the current account deficit in the foreign country increases. At the old rate the current account deficit in the foreign county is larger than the current account surplus in the home country. This causes world interest rates to rise to r_1^W. At this new equilibrium world interest rate, the current account balance in the home country, $S_H - I_H = -(S_F - I_F)$, the current account balance of the foreign country.

1.5. Global Savings Glut

We can use the two-country model to investigate some questions about global imbalances. The basic feature of the global environment is the large US current account deficit and large

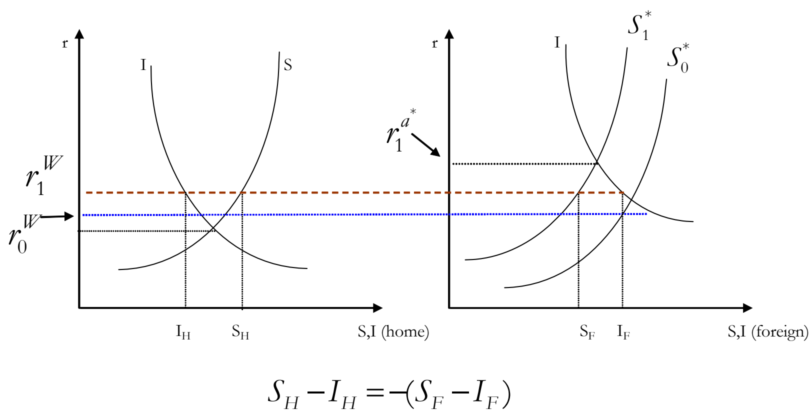

Figure 13: A Decrease in Foreign Savings

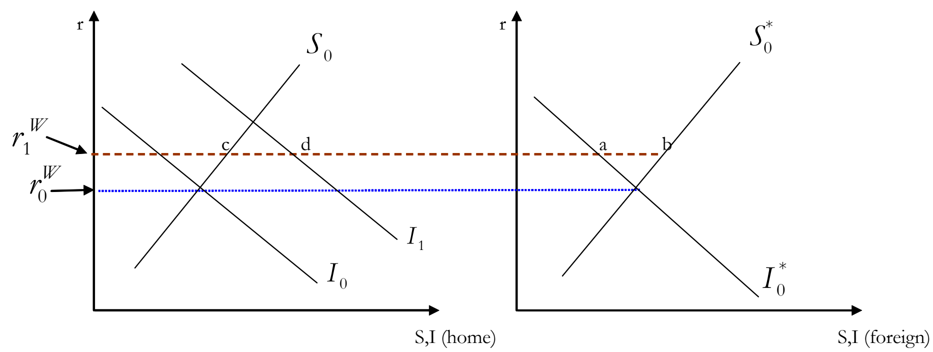

Figure 14: US Fiscal Expansion

current account surpluses in the rest of the world. This raises the question of what is the cause of the imbalance. Notice that the same pattern of imbalances could arise if the US is the "cause," say by excessive fiscal expansion, or if the rest of the world is the cause, by saving "too much." In either case there will be a current account deficit in the US and a current account surplus in ROW.

There is one major difference with these two scenarios, however, and this relates to the world interest rate. Suppose we start with zero current account balances in both countries at interest rate r_0^W as in figure 14. Now suppose that the US has a fiscal expansion, shifting the investment function to the right (I_0). At the old world interest rate there is an excess demand for funds: at r_0^W the US has a current account deficit and ROW does not. The world interest

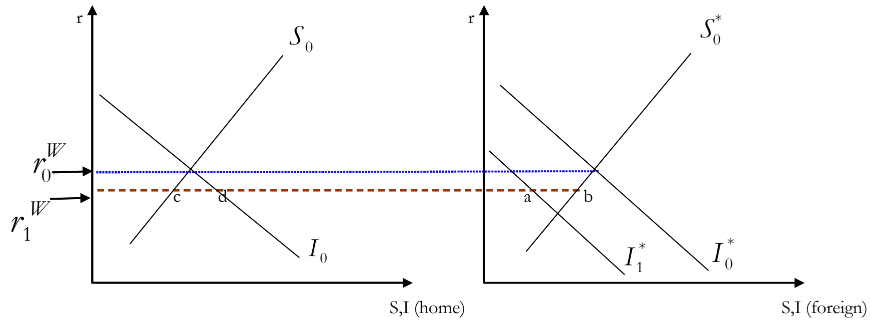

Figure 15: A Global Savings Glut

rate has to rise to r_1^W to satisfy the global market clearing condition ($CA_t + CA_t^* = 0$). In the new equilibrium $CA_t < 0$ and $CA_t^* > 0$. But the key point is that $r_1^W > r_0^W$.

Now consider what happens if the primary mechanism is a glut of foreign savings. This could occur either if foreign savings increases or foreign investment falls. In figure 15.we again start at r_0^W with zero current account balances in both countries. Now shift I^* to the left. This creates a current account surplus in ROW, and to satisfy the global market clearing condition the world interest rate must fall to r_1^W in figure 15. Notice that we have the same pattern of current account balances in the two cases. But there is one key difference: in the glut case world interest rates are low, in the US party case world interest rates are high.

Current global imbalances are a mixture of both cases. The US has experienced a large fiscal expansion. And ROW seems to have an excess of savings over investment. The latter seems important because currently world real interest rates are low, not high. The fact that ROW is willing to buy US iou's at a rapid rate keeps interest rates low and fuels spending in the US (do homebuyers thank the Chinese for low interest rates?). It is rather easy to understand the causes of fiscal expansion. But why a global savings glut? One point that will be important to consider is that countries elsewhere are building up reserves to use as insurance against future currency crises. Countries that experienced large output losses as the result of the Asian crisis, or countries that just observed this, want to have reserves they can use in case another crisis is likely. Thus, they save and hold dollars rather than invest in productive capacity. If this is true, then the lack of alternative means to cope with currency crises is leading to expensive self-insurance schemes. The cost to each country is the difference between the return to investment and the meager return on US Treasury bills. Of course, the US gains, as we are the "sellers" of this insurance.

1.6. The Missing Surplus

The world economy as a whole is closed, so one would expect that world savings would equal world investment. While individual countries can run current account surpluses and deficits, overall these must balance out. This seems obvious, but if we look at the sum of the current accounts from all countries we observe a persistent "world current account deficit." This is evident in the following table.

Table 1: Measured World Current Account Balance, 1980-1993

Billions of US$

year	*World Current Account Balance*
1980	-38.5
1981	-68.3
1982	-100.2
1983	-61.2
1984	-73.4
1985	-80.8
1986	-76.7
1987	-62.3
1988	-78.9
1989	-108.1
1990	-143.8
1991	-122.4
1992	-122.4
1993	-88.8

It is also evident in figure 16 which shows that the statistical discrepancy has grown in

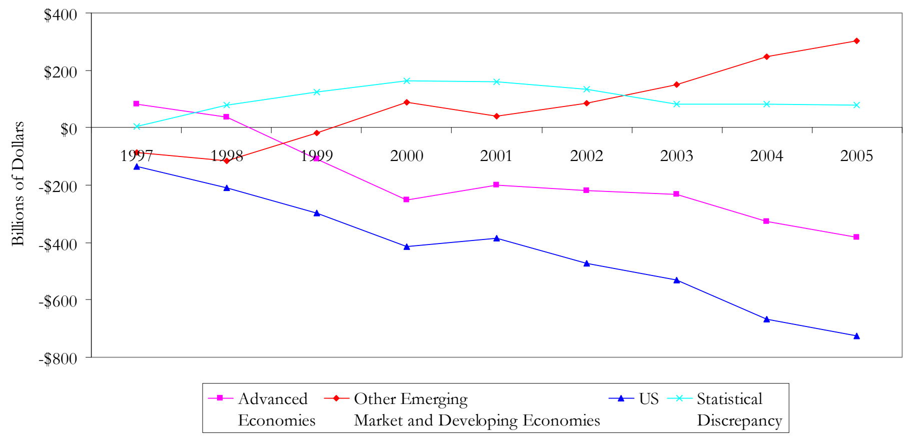

Figure 16: Current Account Balances by Major Grouping

more recent times, as well. Notice that the discrepancies in the table, or in the figure, are quite large; larger in fact than the current accounts of many countries. One would expect errors to cancel out if they are random. Yet the discrepancies here are systematic: the world runs a persistent current account deficit. What might account for this?

One factor could be statistical errors, but a little reflection suggests that this cannot account for the *systematic* bias. A second factor might reflect timing. Goods that are exported in late December of a given year might not reach their destination until January of the next year. Hence, the exports and imports may show up in different years. If we think about oil exports this could explain why this is so large, but it still does not exactly explain the persistent deficit (indeed it seems to predict a surplus).

A more convincing explanation concerns misreporting of interest income. Interest payments earned abroad are often not reported to government authorities in the recipient country. This happens if the recipient wishes to evade taxes. But the payor of the interest will report the transfer. So there will be a debit in the current account of the payor, but not corresponding credit for the recipient (who evades). This could cause a persistent *negative* balance.

Consistent with this explanation is the fact that world interest payments have risen greatly since the early 1980's. As world interest rates declined in the mid-1980's so did the world current account deficit, and as world interest rates rebounded in the late 1980's, the world deficit increased again. So the pattern seems correct. This also is evident in figure 16, since world interest rates have been lower in the recent period than in the 1980's.

A recent IMF study shows that in addition to this factor it appears that most of the world's shipping fleets are registered in countries that do not report maritime freight earnings to the IMF. This accounts for another good part of the deficit.

2. Some Dynamics (Same Theory)

An alternative way to see this is looking at the dynamic analysis of the transition to the steady state. We continue with a two-period model, but focus on life-cycle aspects. Suppose output is given by $Y_t = A_t K_t^{\beta} L_t^{1-\beta}$. This is a Cobb-Douglas production function. It is convenient, has constant returns to scale and diminishing marginal productivity. It is useful to write this in per-capita terms – simply divide through by labor. Then we have

$$\frac{Y}{L} = \frac{1}{L}[AK^{\beta}L^{1-\beta}] = A[\frac{K}{L}]^{\beta} \tag{29}$$

or

$$y = Ak^{\beta}. \tag{30}$$

We can represent this graphically in figure 17:

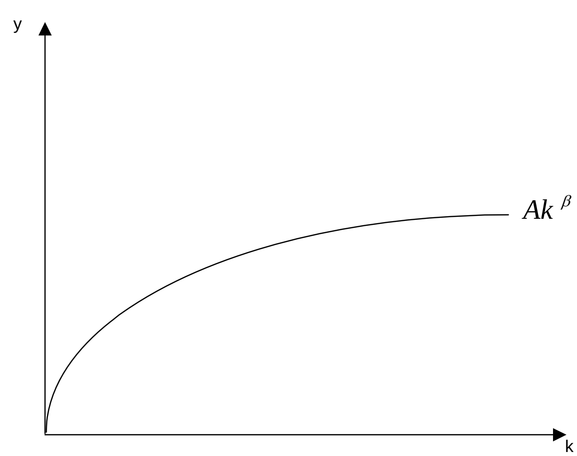

Figure 17: A Nicely Behaved Production Function

Agents work, consume, and save when they are young and spend when they are old. Assume they leave no bequests to make life simple. What do agents earn? We suppose that the wage is equal to the marginal product of labor,[15]

$$w_t = (1-\beta)A_t k_t^{\beta} \tag{31}$$

and the rate of interest is equal to the marginal product of capital, $r_t = \beta A_t k^{\beta-1}$. These derive from profit maximization and are standard assumptions. What do these expressions mean? Because $\beta < 1$ the wage rises with increases in k, but less than proportionally. This makes sense – if you add capital workers are more productive, but how many computers can one person use. With regard to the rate of return, notice that $\beta - 1 < 0$, so increases in k lead to a fall in r. This also makes sense. This is the most important thing to think about these expressions.[16]

Now we further assume that agents consume α of their incomes when young.[17] So savings is equal to $(1-\alpha)w_t$. Capital wears out each period, so the capital stock (per worker) in period $t+1$ is equal to savings of the young; i.e., $k_{t+1} = s_t = (1-\alpha)w_{t.}$ Now substitute from

[15] To see this note that the marginal product of labor is the derivative of the production function with respect to labor: $\frac{\partial Y}{\partial L} = (1-\beta)\, AK^{\beta}L^{-\beta}$, and since $k = \frac{K}{L}$ by definition, it follows that $(1-\beta)\, AK^{\beta}L^{-\beta} = (1-\beta)\, Ak^{\beta}$.

[16] Notice that $r_t k_t = k_t \beta A_t k_t^{\beta-1} = \beta A_t k_t^{\beta}$ is capital's share of income (the rate of return times the capital stock). Now add to this the expression for the wage and we get $\beta A_t k_t^{\beta} + (1-\beta)A_t k_t^{\beta} = A_t k_t^{\beta} = y_t$.

[17] This is obviously makes life simpler. It follows if utility is given by $u = c_1^{\alpha} c_2^{1-\alpha}$ with the budget constraint, $c_1 + c_2(1+r)^{-1} = w$. The FOC for this utility maximization problem are:

$$\alpha c_1^{\alpha-1} c_2^{1-\alpha} = \lambda$$

$$(1-\alpha) c_2^{-\alpha} c_1^{\alpha} = \lambda(1+r)^{-1}$$

so

$$(1-\alpha) c_1^{\alpha} = \alpha c_1^{\alpha-1} c_2 (1+r)^{-1}$$

which implies that $\frac{c_1}{c_2} = \frac{\alpha}{1-\alpha}(1+r)^{-1}$. Now using the budget constraint substitute for c_2 and obtain:

$$\begin{aligned} c_1 &= \frac{\alpha}{1-\alpha}(1+r)^{-1}[(1+r)[w-c_1]] \\ c_1 &= \frac{\alpha}{1-\alpha}[w-c_1] \end{aligned}$$

which can be simplified to:

$$c_1 = \alpha w.$$

expression 31 for w_t. We obtain:

$$k_{t+1} = (1-\alpha)w_t = (1-\alpha)(1-\beta)A_t k_t^{\beta} \quad (32)$$

$$= G(k_t) \quad (33)$$

which we refer to as the *transition equation.*

Why is the transition equation [expression (32)] interesting? Notice that it tells us how the capital stock evolves over time. More specifically, notice that a higher capital stock today means more next period, because it leads to more income and savings, but that there are diminishing returns (since $\beta < 1$). This expression is useful for understanding capital accumulation. It also tells us when the process stops, that is, when we are in the *steady state.* This is the equilibrium where all variables grow at the same rate (so the capital labor ratio is constant). To find this value we set $k_t = k_{t+1}$ in the transition equation:

$$\overline{k} = (1-\alpha)(1-\beta)A_t \overline{k}^{\beta}$$

so

$$\frac{\overline{k}}{\overline{k}^{\beta}} = \overline{k}^{1-\beta} = (1-\alpha)(1-\beta)A_t$$

or

$$\overline{k} = [(1-\alpha)(1-\beta)A_t]^{\frac{1}{1-\beta}} \quad (34)$$

where $\overline{k}$ is the steady state value of the capital-labor ratio, the value where the transition equation intersects the 45 degree line in figure 18:

Notice that if the capital-labor ratio is initially below its steady state value ($k_t < \overline{k}$) then savings leads to increases in the capital labor ratio. Similarly, if we start off with too high a capital stock, we decumulate until we reach $\overline{k}$. Notice that at $\overline{k}$, however, savings is just sufficient to keep the capital-labor ratio constant. There is no net savings or net investment at this value of the capital labor ratio.

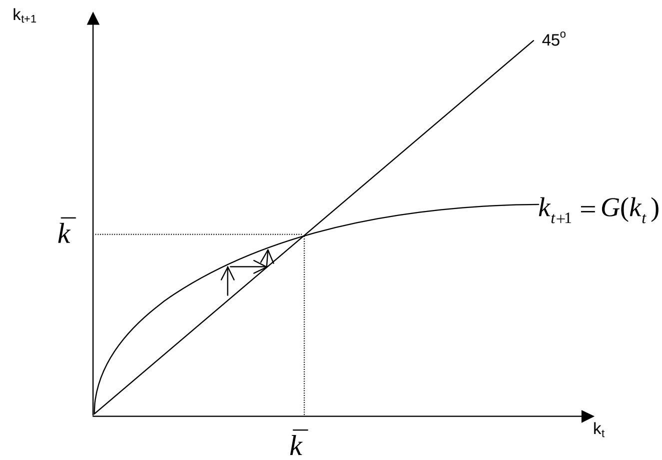

Figure 18: The Transition Equation

We can see some interesting comparative statics from figure 18. Suppose that the level of productivity, A_t increases. This shifts up the transition curve and we have a higher steady-state value of k. Similarly, for a rise in the savings rate. We could think of economies having different steady states because of different values for these parameters.

Now consider the two-country world, with the US and Japan. In figure 19 we show the autarkic equilibrium. We suppose that $\overline{k}_J > \overline{k}_{US}$, which could arise due to a higher savings rate in Japan. Notice that without trade in capital Japan would have higher output, consumption, and savings per person that in the US. As long as Japan had a higher savings rate this would persist.

Now suppose that capital markets are liberalized. Now Japanese savers can invest in the US. Why would they want to? Because the rate of return on capital is lower in Japan with its higher value of k. Recall that the interest rate is given by $r_t = \beta A_t k^{\beta-1}$, so given that $\overline{k}_J > \overline{k}_{US}$,

$$r_{t,J} = \beta A_t k_{t,J}^{\beta-1} < \beta A_t k_{t,US}^{\beta-1} = r_{t,US} \tag{35}$$

It follows that the Japanese would earn a higher return investing in the US. But this would raise capital accumulation in the US and lower it in Japan. With open capital markets this process continues until the rates of return are equal in the two countries. But from expression 35 it is clear that this occurs when the $\overline{k}_J = \overline{k}_{US}$. Notice that this also means that wages are

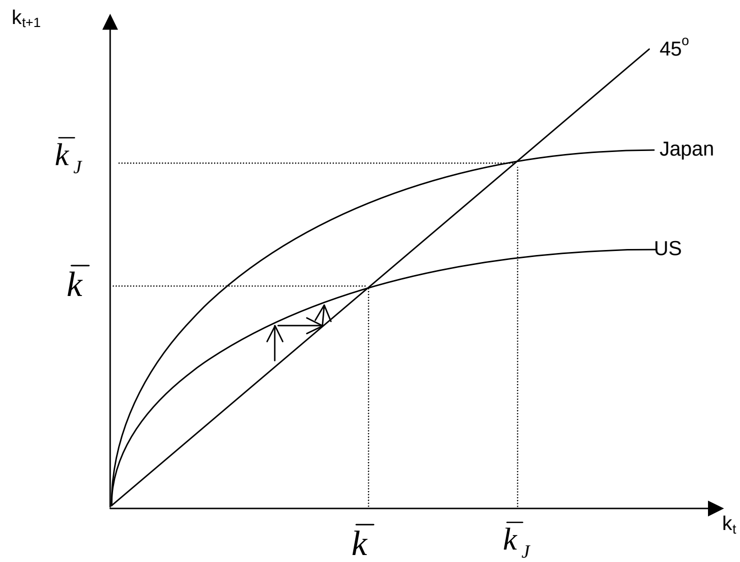

Figure 19: Autarkic Equilibrium

equalized in the two countries. Economists refer to this as *factor price equalization*. We can see this in figure 20 where we converge to the world steady state capital labor ratio, $\overline{k}_w$.

How is $\overline{k}_w$ determined? It is as if there is one country, since factor prices are equalized. So just sum total savings in each country and divide by total population. Letting N^* be the population in Japan and let a_{t+1} be the assets accumulated. Then

$$k_{t+1} = \frac{Na_{t+1} + N^* a^*_{t+1}}{N + N^*} \tag{36}$$

where this is now the world capital labor ratio.

How about the world transition equation? Notice that factor price equalization implies that wages are equalized in the two countries. So asset accumulation differs only by the different savings rates. But world capital accumulation will depend on the world savings rate, which is the weighted average of those in each country:

$$\overline{\alpha} = \frac{N\alpha + N^*\alpha^*}{N + N^*} \tag{37}$$

and the transition equation for the world is given by:

$$k_{t+1} = (1 - \overline{\alpha})(1 - \beta)A_t k_t^{\beta} \tag{38}$$

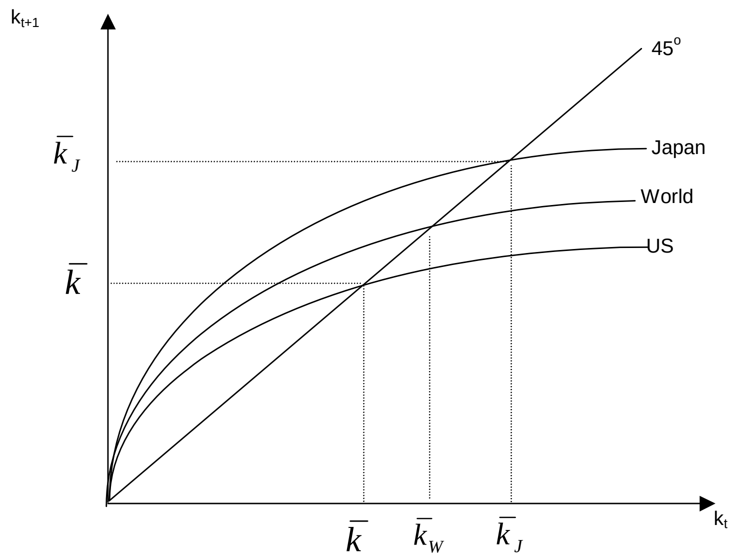

Figure 20: Equilibirium in the Two-Country Model

and which gives the world steady state in the same way as before. This defines the world transition path in figure 20, and we can obtain the steady state capital stock in a similar fashion as before. Note, however, that in the new steady state the capital-labor ratio for each country will be equal to $\overline{k}_w$. If this were not the case then the return to capital would differ in the two countries. Since the US saves less than Japan this means that some of the savings required to have a capital-labor ratio equal to $\overline{k}_w$ will have to come from Japan. Thus Japan will have positive net foreign assets, and the US will have negative net foreign assets.

How about the transition to the new steady state? Suppose that the world capital labor ratio is greater than its steady state value: $k_1 > \overline{k}_w$. To be specific, suppose that initially the US and Japan had equal savings rates, so initially the transition curve was the one labelled *Japan* in figure 21. Notice that at k_1 we can see that asset accumulation is higher in Japan than in the US using figure 21. Now let the US savings rate fall. The new world steady state is at $\overline{k}_w$, but the transition involves a decrease from $\overline{k}_J$ to $\overline{k}_w$. We want to understand this transition. To see this, start at k_1 and read upwards. Using the transition curve for the US we can see that assets in the next period will be a_2^{US} (a_2^J for Japan) while the world capital-labor ratio will be k_2. It is apparent that the US saving is too low ($a_2^{US} < k_2 < a_2^J$). The difference is made up by Japanese investment in the US. So the US has a negative *net foreign asset*

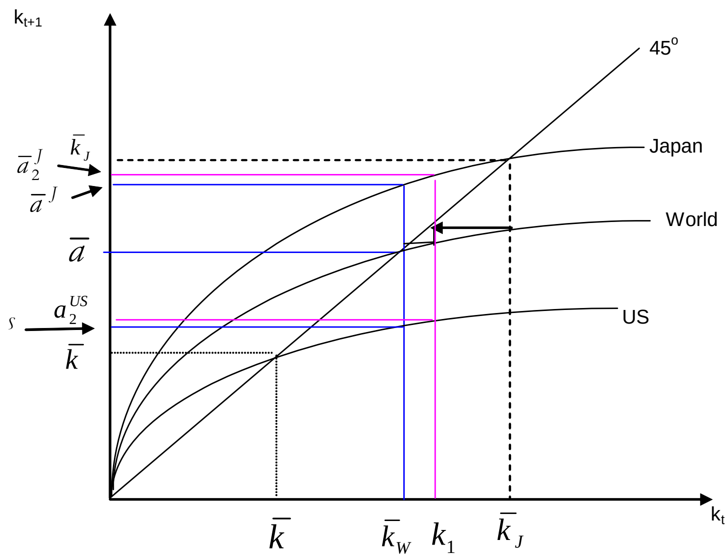

Figure 21: Adjustment to the Steady State: Fall in US Savings Rate

position, while for Japan this is positive. Notice that this will still be true in the steady state, given the position of the transition curves in figure 21.

2.1. Benefits of Capital Mobility

When we move from autarky to capital mobility both countries are better off. The simplest way to see this is to suppose that Japan and the US are equal in size, $N = N^*$, which makes the pictures simpler. And continue to suppose that under autarky, $\overline{k}_J > \overline{k}_{US}$. We know that if capital flows are allowed that we move to a new steady state, $\overline{k}_W$, where $\overline{k}_J > \overline{k}_W > \overline{k}_{US}$. In the new steady state capital flows from Japan to the US. The US is better off because it attracts capital and Japan is better off because it earns a higher rate of return. This is evident if we look at the production function, as in figure 22.

In the new steady state both countries have the common capital-labor ratio, $\overline{k}_W$, so both produce the same output level, $\overline{y}_W$. Clearly $\overline{y}_W > \overline{y}_{US}$ so the US is better off. But so is Japan. To see this, notice that it transfers $\overline{k}_J - \overline{k}_W = AB = ED$ to the US. It earn a rate of return that is higher than it could domestically. This is clear because the rate of return to capital (the tangent at point A) in the open steady state is greater than that at the autarky level for

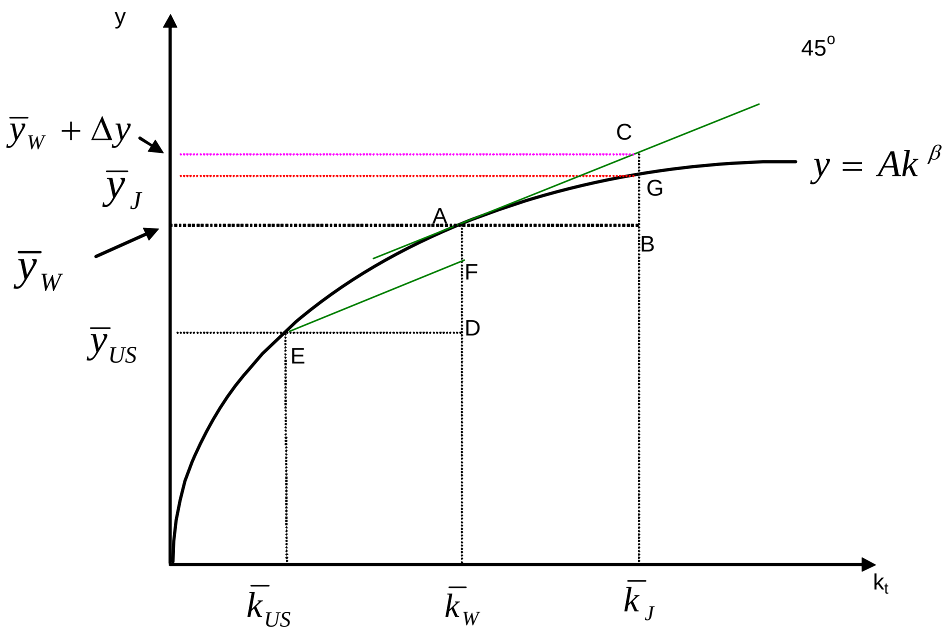

Figure 22: Autarky versus Capital Mobility

Japan (the tangent at point G). Japan's new level of income is thus $\overline{y}_W + \Delta y > \overline{y}_J$ because of the transfer of income from the US. But notice that the US is also better off, net of the transfer, because its per-capita income rises by DA, but it only has to transfer $FD = BC$ to Japan. Thus Japan gains CG and the US gains FA from capital mobility in the new steady state.

Capital mobility improves incomes in both countries because it expands opportunities. We shall have moment to discuss some caveats to this below.

What about a small country? It is easy to think about a small country in the model. The only change in the analysis is that capital accumulation in the small country does not impact the world capital-labor ratio. So the transition curve for the world is given, and changes in the small country effect only its capital-labor ratio.

For example, suppose that a small country, Benin, was closed from the rest of the world and was in steady state, with $\overline{k}_b > \overline{k}_w$ as in figure 23. Now suppose that Benin opens up to the world capital market. Since Benin is small, its behavior cannot effect world interest rates, and since initially its capital-labor ratio was higher than $\overline{k}_w$ this means that interest rates in Benin were below world rates. So savers in Benin will want to hold less capital and more foreign assets. Hence, after opening to the world capital will flow out until $k_b = \overline{k}_w$, and Benin savers will hold net foreign assets $\overline{a}_b$. In fact, this will happen right away in the model because capital wears out each period.

Notice that though the capital-labor ratio falls in Benin, its citizens are better off. They are getting a higher return on their savings, so they can afford higher lifetime consumption. The only odd part of the story is that usually we think of emerging economies as having lower capital-labor ratios. But then opening tells this story in reverse.[18]

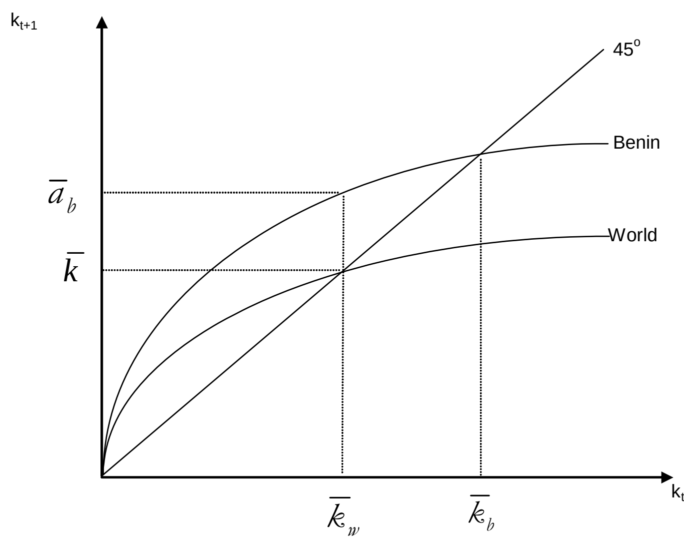

Figure 23: A small country case

2.1.1. Caveat

Notice that the transition to the new steady state $\overline{k}_w$ requires capital to flow from Japan to the US. This leads to factor price equalization. Assuming that capital can move freely between the US and Japan is not a bad assumption. But this may not be true generally. How mobile is capital internationally is an important questions. Not only may countries impose barriers to capital mobility, but there may be institutional barriers as well. Bad policy may

[18] But see the caveat below.

lead to large risk premia which must be paid to attract capital to emerging economies. One reason for this may be currency risk, something we will discuss at length.

Another point to keep in mind is that we have assumed that productivity, A, is equal in both countries. This is unlikely to be true, especially for developing countries. We consider this below in section 2.3..

2.2. Net Foreign Assets

We can say something else about net foreign assets and the trade balance. First, note that net foreign investment (the current account balance) in any period is equal to the change in US net foreign assets (K^f) between periods:

$$I_t^f = K_{t+1}^f - K_t^f. \tag{39}$$

Now if we started in autarky in period 0 then $K_0^f = 0$. With open markets we know that for the US $K_1^f < 0$ as the US will import capital from abroad. That means net foreign investment will also be negative, given expression (39). Eventually we will reach a steady state, however, and then $K_{t+1}^f = K_t^f$ by definition. So eventually net foreign investment will be zero. To recap then, I_t^f starts negative and is zero in the steady state.

Now look to the definition of the current account:

$$I_t^f = X_t - M_t + r_t K_t^f. \tag{40}$$

It follows that in period 0 we must be running a trade deficit ($X_t - M_t < 0$). Why? Well we know that $I_0^f < 0$ and $K_0^f = 0$, so from expression (40) there must be a trade deficit. Can this continue forever? Clearly the answer is no. In the steady state we have seem that I_t^f $= 0$. But we have also seen that in the steady state $K_t^f < 0$.[19] Then from expression (40) it follows that $X_t - M_t > 0$.

We can see this graphically in figure 24. We are in autarky until t_0. With opening we have negative net foreign assets, $-K_1$, and negative current account, $-(X_0 - M_0)$. Eventually

[19] The important point is that K_t^f is the stock of net foreign assets and I_t^f is the change in the stock of net foreign assets. In the new steady state the stock is constant and it is negative.

net foreign assets reach the steady-state level, $-\overline{K}$, at time $\bar{t}$. In the new steady state clearly $\Delta K = I = 0$. But with $\overline{K} < 0$, $r\overline{K} < 0$. So clearly we must have $X_t - M_t = -r\overline{K} > 0$.

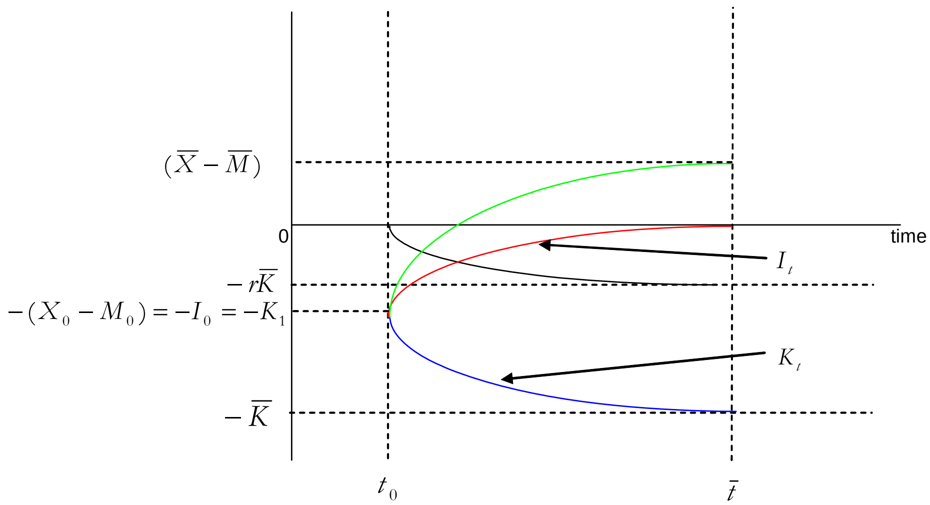

Figure 24: Adjustment to the Steady State

The intuition is clear. Initially the US runs a trade deficit to import capital. But the US must pay interest on the capital. Since net foreign assets are negative in the steady state, the US will have to pay interest each period. Hence, in steady state the US must earn a trade surplus to pay Japan the interest on the capital they invested.

If you have followed the argument to this point you may wonder about the path of the current account (I_t^f). It starts at zero, then becomes negative, then rises back to zero and stays there forever. This may seem to violate the intertemporal budget constraint. Shouldn't the current account be positive in the future to offset the deficit in the initial periods? This is certainly true in any model with a *finite* time horizon. In a finite horizon model there is a last period, and nobody is ever going to plan to hold positive debt after death, since you cannot get paid back after you are dead. If we know that next period is the last period we will arrange our affairs so that accounts are balanced when time is up. But in an infinite time-horizon model, the intertemporal budget constraint is a bit different. There is an infinity of future periods. You can always borrow this period and pay it back next period. That is, you roll over the debt as long as people will lend to you. When will they lend to you? As long as you can service the debt. The constraint is now that the debt not rise so fast that it cannot be serviced. If the debt grew faster than the economy, for example, then eventually the debt would be so large that interest payments would exceed production – an impossible situation.[20] But if the debt is constant and the economy is growing, the burden is falling each period, making repayment easier. In the case we consider net foreign assets are constant in the steady state. Since it is constant, the present value of this amount is going to zero.

2.3. *A Rise in Productivity*

What about an increase in productivity in the US? To make life simple, suppose that initially Japan and the US have the same savings rate, productivity level, and technologies, and that we are initially in steady-state equilibrium. Then we know that $\overline{k}_J = \overline{k}_{US}$, and

$$r_t^{US} = \beta A_t k_{t,US}^{\beta-1} = \beta A_t k_{t,J}^{\beta-1} = r_t^J. \tag{41}$$

Now suppose that $A_t^{US} > A_t^J$. This will cause the transition curve to shift up for the US. At the initial capital stock the rate of return is now higher in the US than in Japan. Japanese savers will want to invest in the US rather than in Japan, which will increase the rate of capital accumulation in the US and speed the adjustment of the capital stock. Japanese savers still save their income at the same rate, α, as before. But they hold more foreign assets and less domestic capital.

Notice that immediately after the productivity change we must have $r_t^{US} = \beta A_t^{US} k_{t,US}^{\beta-1} > \beta A_t^J k_{t,J}^{\beta-1} = r_t^J$ because $A_t^{US} > A_t^J$ and nothing else has changed. The only way returns can become equalized is if $\frac{k_{US}}{k_J}$ rises.[21] This raises the return to investing in Japan and reduces it in the US. So Japan will spend less domestically and acquire more foreign assets. In other words, its current account balance will improve.

[20] This would be a Ponzi game – a process that is only feasible if one can find an increasing number of gullible people each period. But the number required would be exponential. That is why a Ponzi game always collapses. Economists thus refer to the intertemporal budget constraint as a no-Ponzi game condition. For more on Ponzi, see http://en.wikipedia.org/wiki/Ponzi_scheme.

[21] Notice that this means that an improvement in technology in a country leads to more capital accumulation. After the fact we would observe that y increased and that k increased. We might like to know how much of the growth in income was due to technology and how much to capital accumulation. But our measurement could be distorted by the *induced* investment that was the result of the improvement in A. Why is this important? Because in practice, economists measure A as a residual after measuring the effect of the growth in k on y.

Since we started with (41) net capital flows were zero in the initial equilibrium. The increase in productivity will cause a net capital inflow, so $K^f_{t+1} > K^f_t$ for Japan, and $K^f_{t+1} < K^f_t$ for the US. That is, $I^f_{t,J} > 0$ and $I^f_{t,US} < 0$. This follows because Japanese savers are acquiring more US assets than they are selling (and vice versa). From (39) and (40) it follows that the current account in Japan must become positive and in the US it must become negative. The deterioration of the US current account is, of course, just another way of noting the inflow of foreign capital – the net capital inflow. The current account deficit is enabling the US to adjust to the productivity improvement. Japanese savers (whose preferences, recall are identical to American savers' preferences) will hold more US assets to improve the average return on their savings. To do so requires them to accumulate foreign assets, and this can only be done through current account surpluses. In the steady state $\overline{k}_J$ and $\overline{k}_{US}$ will be constant, so no further net foreign accumulation is necessary. The adjustment of the current account and net foreign assets looks the same as in figure 24. Future US current account surpluses are needed to repay the current account deficit.

This response of the current account to a rise in productivity may be a good explanation of why the US had a current account deficit in the 1990's. Capital flowed to the US in response to a rise in productivity. This seems less likely to explain the situation in the last several years, as is evident in figure 25. You can clearly see that investment was increasing in the 1990's, but that it has declined as a share of GDP since 2000. Meanwhile, there has been a big decline in net public savings.

In the new steady state output is higher in the US than before. This new higher level of output allows the US to service the debt (or transfer the income on foreign-owned capital) to Japan. This transfer allows Japan to have higher consumption than would be possible in autarky, since in that case Japan would not be able to share in the productivity gains in the US. Is the US also better off in the open case? Certainly. In the autarchic case there would be less savings available, so it would take longer to get to the new steady-state $\overline{k}$. The present value of consumption would thus be lower. With open capital markets we get to the new steady-state value sooner, so total consumption possibilities are increased. The Japanese

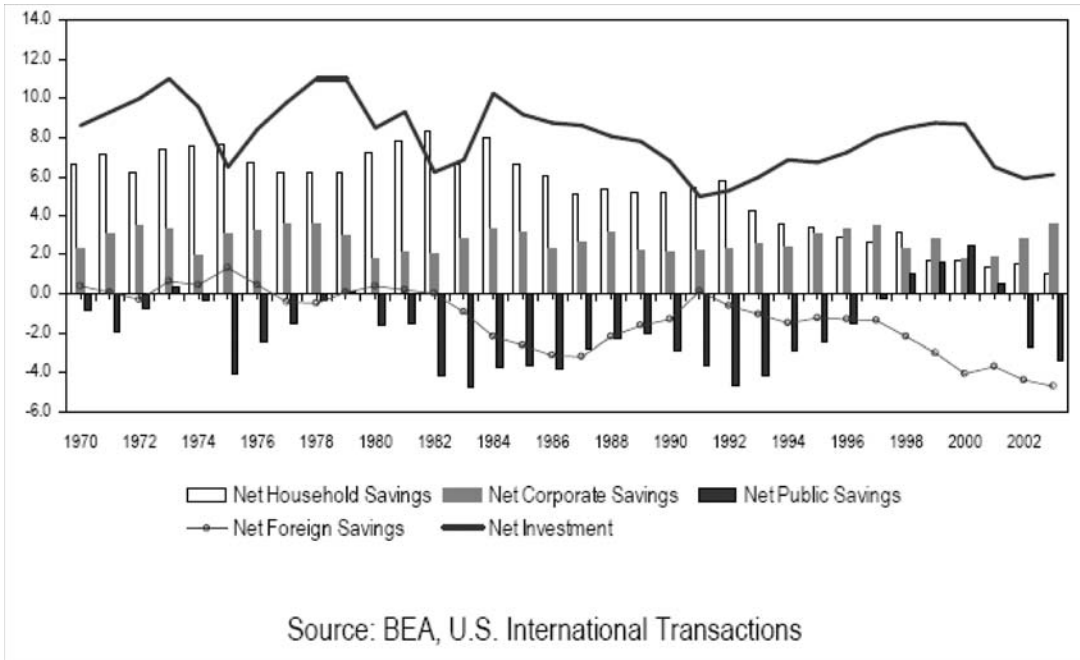

Figure 25: US Savings and Investment, 1970-2003

obtain some of these gains, but not all.

Notice that as $\frac{k_{US}}{k_J}$ increases $\frac{r^{US}}{r_J}$ will decrease. Thus the interest differential will fall until we reach the new steady state. In the new steady state, we must have $\overline{k}_J < \overline{k}_{US}$.[22] It is the capital stock that adjusts to the difference in productivity levels. If these differences remain, so will capital-labor ratios.[23] That helps explain why capital flows do not equalize capital-labor ratios in the US and India. If you ignored the differences in productivity then you would expect the return to capital to be higher in the poorer country as it has less capital. Then you might expect capital to flow from rich to poor countries. This does not seem to happen. One reason is risk, of course, and we shall have lots of reasons to discuss this. But another is productivity, and it is worth a mention here. A little arithmetic will go a long way right now.

[22] How much larger the US capital stock will be than Japan's clearly depends on β, which determines the rate at which the interest rate changes as k does.

[23] Notice that now we have different steady-state capital-labor ratios in the two countries. This was not the case when we looked at different savings rates. The reason is that differences in productivity affect the marginal product of capital. So for factor price equalization $k's$ will have to differ.

First, let us suppose that there were not differences in productivity. India's per-capita income is about $\frac{1}{15}$ that of the US. If $A_{India} = A_{US}$, it follows that

$$15 = \frac{k_{US}^{\beta}}{k_{India}^{\beta}}$$

Now a good estimate of β (capital's share of national income) would be 0.4 (a rough average of the two countries). This would imply that the capital-labor ratio in the US is $15^{2.5} \approx 871$ times greater than it is in India. This is obviously way too high. It would imply that we save at a rate (per worker) that is 800 times higher than that of India. Moreover, if the capital labor ratio were really this much higher in the US than in India, the return to capital in India would be about 58 times higher.[24] But this should mean that capital should flow from the US to India at quite a rapid rate. Some does, but not that much.[25] Why? One reason could be TFP differences: $A_{India} < A_{US}$ would alter the rate of return calculation.[26] Explaining these differences is one of the most important issues in development economics. But we will ignore them here (for the most part).

2.4. *War and the Current Account*

War provides an interesting way to test some of the predictions of the model. During a war expenditure rises above its long-run level, while savings typically decreases. Future income is borrowed against to fight the war. It is a period of temporarily high spending, so we would expect the current account to deteriorate.

In non-belligerent countries, on the other hand, the terms for lending improve. In terms of figure 11 the SS curve shifts to the left for the belligerents. The world interest rate must rise. This increases the return to the neutral countries from lending. We should expect the current

[24] To see this, note that if we ignore A, the marginal product of capital per worker is $r = \beta k^{\beta-1}$. From expression 30 it follows that $k = y^{1/\beta}$. Now using this in the expression for r, we obtain $r = \beta y^{\frac{\beta-1}{\beta}}$. Since $y_{US} = 15 * y_{India}$, we have $r_{India} = r_{US} 15^{\frac{3}{2}}$. Now $15^{1.5}$ is about 58, so the rate of return would have to be 58 times higher in India than the US.

[25] This is sometimes referred to as the Lucas Paradox. Robert Lucas first pointed out that capital flows to developing countries were too small compared with predictions of standard economic models.

[26] You can see this by taking the opposite assumption: $r_{US} = r_{India}$, and letting differences in A explain the higher US output.

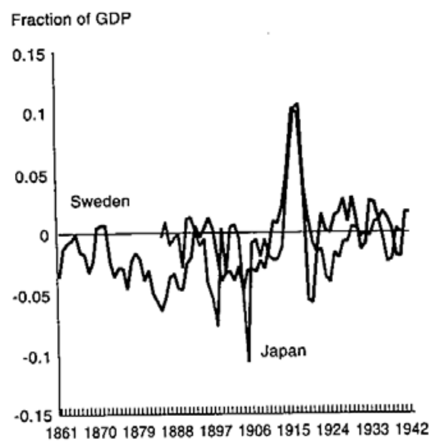

Figure 1.6
Current accounts of Japan and Sweden, 1861–1942

Figure 26: Current Account Balances in Japan and Sweden

accounts of the neutral countries to improve. This feature is indeed evident in the experience of Japan and Sweden in WW1, as in figure 26.

Lending by neutrals to belligerents is an old feature of history. But there is one limitation. A sovereign borrower may repudiate his debts.[27] There is no enforcement mechanism you can use against a sovereign borrower, short of war.[28] This is what Edward III did after his invasion of France yielded poor results. As a consequence, international lending is constrained by fear of repudiation as well. Success in war increases borrowing ability. This means that the observed effect of war on the current account is attenuated somewhat by the fear of repudiation.[29]

[27] According to Adam Smith: "When national debts have once been accumulated to a certain degree, there is scarce, I believe, a single instance of their having been fairly and completely paid. The liberation of public revenue, if it has ever been brought about at all, has always been brought about by a bankruptcy; sometimes by an avowed one, but always by a real one, though frequently by a pretended payment [in a depreciated currency]...When it becomes necessary for a state to declare itself bankrupt, in the same manner as when it becomes necessary for an individual to do so, a fair, open, and avowed bankruptcy is always the measure which is both least dishonourable to the debtor, and least fruitful to the creditor." Wealth of Nations, Book V, Chapter III, 882.

[28] You may wonder then why people lend to sovereigns; that is, why don't they always repudiate debts. What is the sanction that prevents repudiation? This is an interesting question. Is access to capital markets the answer? That is, do countries fear the loss of future borrowing opportunities so much that they pay back loans that they otherwise would repudiate? This is an interesting theory, but what about countries that default on their debts but still are able to borrow in international markets? We will return to this issue later.

[29] When the Russo-Japanese war broke out, Japan borrowed at an annual rate of 7.5%, but by 1905, once it was clear that Japan was going to win the war its cost of borrowing fell to 5.5%.